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In re Patent Application of	)
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Reinhard JOHO	) Group Art Unit: Unassigned
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Application No.: 09/996,694	) Examiner: Unassigned
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Filed: November 30, 2001	)
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For: PROCESS FOR THE PRODUCTION OF A ROTOR, CONTAINING PERMANENT MAGNETS, OF A SYNCHRONOUS MACHINE, AND ROTOR PRODUCED ACCORDING TO THIS PROCESS	)

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination of the above-captioned patent application, Applicant requests that the following amendments be entered. The amendments are incorporated in the formatted Substitute Specification submitted herewith. A copy of the certified translation of the original application, together with a CompareRite® version showing the amendments made to the original application, in accordance with 37 C.F.R. §1.121 (2001), are also submitted herewith. No new matter has been introduced in these amendments to the original specification.

IN THE ABSTRACT:

Please delete the existing Abstract and substitute the Abstract attached hereto as a separate sheet.

IN THE CLAIMS:

Please replace claims 1-34 with the corresponding amended claims.

1. (Amended) Process for the production of a rotor of a synchronous machine, containing permanent magnets, the rotor having a core of ferromagnetic steel, on and connected to which core are permanent magnets which in their turn are surrounded by an outer cylinder of a non-magnetizable material, and which rotor has at both axial ends a closure disk of a non-magnetizable steel with a stub shaft, wherein the core is constituted with an internal space, the process comprising:

introducing a resin mass into the internal space;

supplying said resin mass to a region of the permanent magnets by centrifuging the rotor; and

hardening of the resin mass in the region of the permanent magnets.

2. (Amended) Process according to claim 1, further comprising:

heating and simultaneously running up to a centrifuging speed the rotor with the introduced resin mass, such that the resin mass is conducted outward, due to centrifugal force, from the internal space through radial channels in the core, or from the internal

space through holes and longitudinal slots in the core, to the region of the permanent magnets, and the cavities present there are filled up; and

maintaining the rotor at the centrifuging speed during the hardening of the resin mass.

3. (Amended) Process according to claim 1, further comprising:

arranging the permanent magnets on the core by inserting the permanent magnets with play into the outer cylinder;

arranging at each end after the introduction of the resin mass into the internal space the respective closure disk, each closure disk consisting of non-magnetizable steel with a stub shaft and the core centered in the closure disks; and

connecting the outer cylinder to the closure disks.

4. (Amended) Process according to claim 1, wherein the resin mass is introduced into the internal space in the core in the form of a solid rod.

5. (Amended) Process according to claim 1, wherein the resin mass contains at least one filler.

6. (Amended) Process according to claim 1, wherein the outer cylinder is shrunk onto the closure disks.

7. (Amended) Process according to claim 6, wherein the shrunk-on outer cylinder is connected flush to the closure disks by means of a circumferential weld seam.

8. (Amended) Process according to claim 7, wherein the circumferential weld seam is pre-welded in only one pass before the centrifuging of the resin and is only completely after-welded after the hardening of the resin.

9. (Amended) Process according to claim 6, wherein the outer cylinder is constituted at both ends with an inner circumferential groove and the closure disks are constituted with an outer circumferential projection and an adjacently arranged outer circumferential groove with an inserted O-ring, and the outer cylinder is shrunk onto the closure disks such that the respective outer circumferential projection of the closure disks projects into the respective inner circumferential groove, and the respective O-ring abuts the outer cylinder flush.

10. (Amended) Process according to claim 1, wherein the closure disks are constituted with a cone-shaped portion directed toward the rotor interior, and are pressed into the outer cylinder, to connect with it, as far as a stop.

11. (Amended) Process according to claim 1, wherein magnetic neutral zones are present in annular space portions between the core and the outer cylinder, which neutral zones contain no permanent magnets, and the process further comprises inserting filler

pieces into said annular space portions, the density of the material of the filler pieces being at least approximately equal to the density of the material of the permanent magnets.

12. (Amended) Process according to claim 1, further comprising inserting a filler strip between adjacent permanent magnets.

13. (Amended) Process according to claim 1, further comprising inserting a further filler strip between the permanent magnets and the inner circumferential regions of the outer cylinder lying opposite said permanent magnets.

14. (Amended) Process according to claim 13, further comprising:

forming a damping cage by connecting the further filler strips at their ends to a respective flexibly constituted ring;

arranging said further filler strips around the core; and

installing the closure disks.

15. (Amended) Process according to claim 1, further comprising:

producing a cage of an electrically conductive material with end rings and axially-running longitudinal rods with transverse grooves for distributing the resin;

inserting the permanent magnets into the cage; and

pushing the cage with the permanent magnets into the outer cylinder followed by adhering the permanent magnets to the outer cylinder with a provisional

adhesive and thereafter pushing the core into the cage, or pushing the core into the cage and thereafter pushing the outer cylinder over the cage with the permanent magnets.

16. (Amended) Process according to claim 1, further comprising stacking metal sheets on a centering tube to produce the core, the centering tube having holes for the passage of resin mass arranged in the internal space and the metal sheets having slots aligned with the holes for the further passage of the resin.

17. (Amended) Process according claim 1, wherein the core is integral and is constituted with an internal space, which internal space serves as a storage space for the resin mass, and from which internal space channels are constituted running in a radial direction toward the outside of the core.

18. (Amended) Process according to claim 1, wherein the core is constituted at both axial ends with a polygonal recess, each closure disk being constituted with a polygonal projection corresponding to the recesses of the core, and the process further comprises inserting the projections into the recesses during assembly of the rotor in order to form a positive connection for force transmission between the core and the closure disks.

19. (Amended) Process according to claim 1, wherein the core has an outer circumferential surface constituted of polygonal shape with many planar surface portions, the dimensions of each individual surface portion being conformed to the dimensions of the

permanent magnets so that a magnetic gap formed between the core and the permanent magnets arranged on the surface portions is minimized, and a predetermined transmission of torque from the permanent magnets to the core is attained.

20. (Amended) Rotor containing permanent magnets, the rotor comprising:

a core of ferromagnetic steel;

an internal space running axially;

at least one permanent magnet arranged on the core;

an outer cylinder of non-magnetizable material surrounding the at least one permanent magnet; and

closure disks of non-magnetizable steel, each closure disk having a stub shaft and positively connected to the core and at least frictionally connected to the outer cylinder,

wherein after interfusing a resin at least a plurality of the cavities in the region of the permanent magnet are filled with the resin as far as the diameter of the internal space.

21. (Amended) Rotor according to claim 20, wherein the outer cylinder is shrunk onto the closure disks.

22. (Amended) Rotor according to claim 21, wherein the shrunk-on outer cylinder is connected flush to the closure disks by means of a circumferential weld seam.

23. (Amended) Rotor according to claim 21, wherein the outer cylinder has a circumferential groove at each end, and the closure disks have an outer circumferential projection and an adjacently arranged circumferential groove with an inserted O-ring, said outer circumferential projections projecting into the respective inner circumferential groove and said O-ring abutting the outer cylinder flush.

24. (Amended) Rotor according to claim 20, wherein each closure disk has a cone-shaped portion directed toward the rotor interior and has a shoulder portion serving as a stop, said closure disks being pressed into the outer cylinder and abutting it with the shoulder portion.

25. (Amended) Rotor according to claim 20, further comprising:

a plurality of annular space portions between the core and the outer cylinder defining a plurality of magnetic neutral zones, said neutral zones containing no permanent magnets; and

a plurality of filler pieces arranged in the annular portions, the filler pieces having a density at least approximately the same as a density of the permanent magnets.

26. (Amended) Rotor according to claim 20, further comprising a filler strip arranged between adjacent permanent magnets.

27. (Amended) Rotor according to claim 20, further comprising a further filler strip arranged between the permanent magnets and the inner circumferential regions of the outer cylinder opposite to the permanent magnets.

28. (Amended) Rotor according to claim 27, wherein the further filler strip consists of an electrically conducting material and, for the formation of a damping cage, are connected at their ends to a flexibly constituted ring within which the core is arranged.

29. (Amended) Rotor according to claim 20, further comprising a cage of electrically conducting end rings and longitudinal rods with transverse grooves for the distribution of the resin, the permanent magnets being inserted into said cage.

30. (Amended) Rotor according to claim 20, wherein the core is formed by a metal sheet packet comprising a plurality of metal sheets arranged on a centering tube, the centering tube having a plurality of holes, wherein the metal sheets have longitudinal slots running in the radial direction and aligned with the holes.

31. (Amended) Rotor according to claim 20, wherein the core is integral and has an internal space from which a plurality of channels run in a radial direction to the outside of the core.

32. (Amended) Rotor according to claim 20, wherein, for torque transmission from the core to the closure disks, the core has a polygonal recess at each axial end, and each closure disk has a polygonal projection projecting into the respective recess.

33. (Amended) Rotor according to claim 20, wherein the core has a polygon-shaped outer circumferential surface, consisting of individual plane-surfaced surface portions, whereby the surface portions correspond to the dimensions of the permanent magnets abutting the same.

34. (Amended) Rotor according to claim 20, wherein the core is formed by a metal sheet packet comprising a plurality of metal sheets and a plurality of shear bolts inserted at one end into the metal sheets and at a second end into the closure disks.

Please add new claim 35 as follows.

35. (New) Process according to claim 14, wherein the further filler strips are connected by spot welding.

REMARKS

By way of the foregoing amendments, claims 1-34 have been amended to place them in better form for examination and claim 35 added. No new matter has been added. Support for the amended and the new claims can be found, for example, in at least the following: the original claims, written description and figures.

Early and favorable consideration with respect to this application is respectfully requested.

Should any questions arise in connection with this application, the undersigned respectfully requests that he be contacted at the number indicated below.

Respectfully submitted,

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Date: April 22, 2002

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Marked-up Claims 1-34

1. (Amended) Process for the production of a rotor of a synchronous machine, containing permanent magnets [(2)], the [said] rotor having a core [(1, 35)] of ferromagnetic steel, on and connected to which core [(1, 35)] are permanent magnets [(2)] which in their turn are surrounded by an outer cylinder [(3)] of a non-magnetizable material, and which rotor has at both axial ends a closure disk [plates (4, 5)] of a non-magnetizable steel with a stub shaft [shafts (6, 7)], wherein the core [(1, 35)] is constituted with an internal space [(8, 36) and], the process comprising:

introducing a resin mass [is introduced] into the internal space [(8, 36), the];

supplying said resin mass [being supplied] to [the] a region of the permanent magnets [(2)] by centrifuging the rotor[, in which region]; and

hardening of the resin mass [takes place] in the region of the permanent magnets.

2. (Amended) Process according to claim 1, further comprising:

[wherein the rotor with the introduced resin mass is heated] heating and simultaneously [run] running up to a centrifuging speed the rotor with the introduced resin mass, such that the resin mass [being] is conducted outward, due to centrifugal force, from the internal space [(8)] through radial channels [(27)] in the core [(1)], or from the internal space [(36)] through holes [(25)] and longitudinal slots [(26)] in the core [(35)], to the region of the permanent magnets [(2)], and the cavities present there are filled up[,]; and

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[wherein] maintaining the rotor [is kept] at the centrifuging speed during the hardening of the resin mass.

3. (Amended) Process according to claim 1 [or 2, wherein for the assembly of the rotor, the permanent magnets (2) are arranged], further comprising:

arranging the permanent magnets on the core [(1, 35), and the core (1, 35) with the permanent magnets (2) is inserted] by inserting the permanent magnets with play into the outer cylinder [(3)];

[and wherein after the introduction of the resin mass into the internal space (8, 36), a] arranging at each end after the introduction of the resin mass into the internal space the respective closure disk, [plate (4, 5)] each closure disk consisting of non-magnetizable steel with a stub shaft [(6, 7) is arranged at each end of this structure originating from the core (1, 35), permanent magnets (2), outer cylinder (3) and resin mass,] and the core [(1, 35) is] centered in the closure disks [(4,5)]; and

[wherein finally] connecting the outer cylinder [(3) is connected] to the closure disks [(4, 5)].

4. (Amended) Process according to [one of the foregoing claims] claim 1, wherein the [hardenable] resin mass is introduced into the internal space [(8, 36)] in the core [(1, 35)] in the form of a solid rod.

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5. (Amended) Process according to [one of the foregoing claims] claim 1, wherein the resin mass contains at least one filler.

6. (Amended) Process according to [one of the foregoing claims] claim 1, wherein the outer cylinder [(3)] is shrunk onto the closure disks [(4, 5)].

7. (Amended) Process according to claim 6, wherein the shrunk-on outer cylinder [(3)] is connected flush to the closure disks [(4, 5)] by means of a circumferential weld seam [(9)].

8. (Amended) Process according to claim 7, wherein the circumferential weld seam [(9)] is pre-welded in only one pass before the centrifuging of the [adhesive] resin and is only completely after-welded after the hardening of the [adhesive] resin.

9. (Amended) Process according to claim 6, wherein the outer cylinder [(3)] is constituted at both ends with an inner circumferential groove [(10)] and the closure disks [(4, 5)] are constituted with an outer circumferential projection [(11)] and an adjacently arranged outer circumferential groove [(12)] with an inserted O-ring [(13)], and the outer cylinder [(3)] is shrunk onto the closure disks [(4, 5)] such that the respective outer circumferential projection [(11)] of the closure disks [(4, 5)] projects into the respective

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inner circumferential groove [(10)], and the respective O-ring [(13)] abuts the outer cylinder [(3)] flush.

10. (Amended) Process according to [one of claims 1-5] claim 1, wherein the closure disks [(4, 5)] are constituted with a cone-shaped portion [(14)] directed toward the rotor interior, and are pressed into the outer cylinder [(3)], to connect with it, as far as a stop [(15)].

11. (Amended) Process according to [one of the foregoing claims] claim 1, wherein magnetic neutral zones [(37)] are present in annular space portions between the core [(1, 35)] and the outer cylinder [(3)], which neutral zones [(37)] contain no permanent magnets [(2)], and the process further comprises inserting [wherein] filler pieces [(16) are inserted] into [these] said annular space portions, the density of the material of the filler pieces [(16)] being at least approximately equal to the density of the material of the permanent magnets [(2)].

12. (Amended) Process according to [one of the foregoing claims] claim 1, [wherein] further comprising inserting a filler strip [strips (20) are inserted] between adjacent permanent magnets [(2)].

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13. (Amended) Process according to [one of the foregoing claims] claim 1, [wherein] further comprising inserting a further filler strip [strips (21) are inserted] between the permanent magnets [(2)] and the inner circumferential regions of the outer cylinder [(3)] lying opposite said permanent magnets.

14. (Amended) Process according to claim 13, [wherein, in order to form] further comprising:

forming a damping cage[,] by connecting the further filler strips [(21) are connected] at their ends [by spot welding or the like] to a respective flexibly constituted ring [(22) and are arranged];

arranging said further filler strips around the core [(1, 35),]; and

installing the closure disks [(4, 5) are then installed].

15. (Amended) Process according to [one of claims 1-11] claim 1, [wherein] further comprising:

producing a cage [(29)] of an electrically conductive material [is produced,] with end rings [(30)] and axially-running longitudinal rods [(31)] with transverse grooves [(32)] for distributing the [adhesive] resin[, and];

inserting the permanent magnets [(2) are inserted] into the cage [(29)]; and

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[wherein either] pushing the cage [(29)] with the permanent magnets [(2) is pushed] into the outer cylinder [(3),] followed by adhering the permanent magnets [(2) are adhered] to the outer cylinder [(3)] with a provisional adhesive and thereafter pushing the core [(1, 35) is pushed] into the cage [(29)], or pushing the core [(1, 35) is first pushed] into the cage [(29)] and thereafter pushing the outer cylinder [(3) is pushed] over the cage [(29)] with the permanent magnets [(2)].

16. (Amended) Process according to [one of claims 1-14] claim 1, [wherein] further comprising stacking metal sheets [(23) are stacked] on a centering tube [(24) for the production of] to produce the core [(35)], [which] the centering tube [(24) has] having holes [(25)] for the passage of resin mass arranged in [its] the internal space [(36),] and the metal sheets [(23)] having slots [(26)] aligned with the holes [(25)] for the further passage of the [adhesive] resin.

17. (Amended) Process according [to one of claims 1-15] claim 1, wherein the core [(1)] is integral and is constituted with an internal space [(8)], which internal space [(8)] serves as a storage space for the resin mass, and from which internal space [(8)] channels [(27)] are constituted running in a radial direction toward the outside of the core [(1)].

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18. (Amended) Process according to [one of the foregoing claims] claim 1, wherein the core [(1, 35)] is constituted at both axial ends with a polygonal recess [(18)], each closure disk [(4, 5)] being constituted with a polygonal projection [(19)] corresponding to the recesses [(18)] of the core [(1, 35);], and the process further comprises inserting [wherein, in assembling the rotor,] the projections [(19)]are inserted] into the recesses [(18),] during assembly of the rotor in order to form a positive connection for force transmission between the core [(1, 35)] and the closure disks [(4, 5)].

19. (Amended) Process according to [one of the foregoing claims] claim 1, wherein [the outer circumferential surface of] the core [(1, 35) is] has an outer circumferential surface constituted of polygonal shape with many planar surface portions [(17)], the dimensions of each individual surface portion being conformed to the dimensions of the permanent magnets [(2),] so that [on the one hand] a [minimum] magnetic gap [is] formed between the core [(1, 35)] and the permanent magnets [(2)] arranged on the surface portions is minimized [(17)], and [on the other hand an excellent] a predetermined transmission of torque from the permanent magnets [(2)] to the core [(1, 35)] is attained.

20. (Amended) Rotor containing permanent magnets, the rotor comprising: [(2), produced by the process according to claim 1, which has]

a core [(1, 35)] of ferromagnetic steel; [and]

an internal space [(8, 36)] running axially;[, on which core (1, 35)]

at least one permanent [magnets (2) are] magnet arranged on the core;[, and which is surrounded by]

an outer cylinder [(3)] of non-magnetizable material surrounding the at least one permanent magnet; and [, the said rotor having]

closure disks [(4, 5)] of non-magnetizable steel, each closure disk having a [with] stub [shafts (6, 7), which are] shaft and positively connected to the core [(1, 35)] and at least frictionally connected to the outer cylinder, [(3); and]

wherein after interfusing [the] a resin at least [all] a plurality of the cavities in the region of the permanent [magnets (2)] magnet are filled with [a] the resin [mass] as far as the diameter of the internal space [(8, 36)].

21. (Amended) Rotor according to claim 20, wherein the outer cylinder [(3)] is shrunk onto the closure disks [(4, 5)].

22. (Amended) Rotor according to claim 21, wherein the shrunk-on outer cylinder [(3)] is connected flush to the closure disks [(4, 5)] by means of a circumferential weld seam [(9)].

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23. (Amended) Rotor according to claim 21, wherein the outer cylinder [(3)] has a circumferential groove [(10)] at each end, and the closure disks [(4, 5)] have an outer circumferential projection [(11)] and an adjacently arranged circumferential groove [(12)] with an inserted O-ring [(13)], [with the] said outer circumferential projections [(11)] projecting into the respective inner circumferential groove [(10)] and [the] said O-ring [(13)] abutting the outer cylinder [(3)] flush.

24. (Amended) Rotor according to claim 20, wherein each closure disk [(4, 5)] has a cone-shaped portion [(14)] directed toward the rotor interior and has a shoulder portion [(15)] serving as a stop, [the] said closure disks [(4, 5)] being pressed into the outer cylinder [(3)] and abutting it with the shoulder portion [(15)].

25. (Amended) Rotor according to [one of claims 20-24] claim 20, further comprising:

[with magnetic neutral zones (37) present in the] a plurality of annular space portions between the core [(1, 35)] and the outer cylinder [(3)] defining a plurality of magnetic neutral zones, [the] said neutral zones [(37)] containing no permanent magnets[, wherein]; and

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a plurality of filler pieces [(16) are] arranged in [these] the annular portions, [the density of the material of] the filler pieces [(16) being] having a density at least approximately the same as [the] a density of [the material of] the permanent magnets [(2)].

26. (Amended) Rotor according to [one of claims 20-25, wherein] claim 20, further comprising a filler [strips (20) are] strip arranged between adjacent permanent magnets [(2)].

27. (Amended) Rotor according to [one of claims 20-26, wherein] claim 20, further comprising a further filler [strips (21) are] strip arranged between the permanent magnets [(2)] and the inner circumferential regions of the outer cylinder [(3)] opposite to [these] the permanent magnets.

28. (Amended) Rotor according to claim 27, wherein the further filler [strips (21) consist] strip consists of an electrically conducting material and, for the formation of a damping cage, are connected at their ends to a flexibly constituted ring [(22)] within which the core [(1, 35)] is arranged.

29. (Amended) Rotor according to [one of claims 20-25, wherein it has] claim 20, further comprising a cage [(29)] of electrically conducting end rings [(30)] and

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longitudinal rods [(31)] with transverse grooves [(32)] for the distribution of the [adhesive] resin, the permanent magnets [(2)] being inserted into [the] said cage [(29)].

30. (Amended) Rotor according to [one of claims 20-28] claim 20, wherein the core [(35)] is formed by a metal sheet packet comprising a plurality of metal sheets arranged on a centering tube [(24) which], the centering tube [(24) has] having a plurality of holes [(25)], [and] wherein the metal sheets [(23) of the metal sheet packet at these holes (25)] have longitudinal slots [(26)] running in the radial direction and aligned with the holes [(25)].

31. (Amended) Rotor according to [one of claims 20-29] claim 20, wherein the core [(1)] is integral and has an internal space [(8)] from which [internal space (8)] a plurality of channels [(27)] run in a radial direction to the outside of the core [(1)].

32. (Amended) Rotor according to [one of claims 20-31] claim 20, wherein, for torque transmission from the core [(1, 35)] to the closure disks [(4, 5)], the core [part (1, 35)] has a polygonal recess [(18)] at each axial end, and each closure disk [(4, 5)] has a polygonal projection [(19)] projecting into the respective recess [(18)].

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33. (Amended) Rotor according to [one of claims 20-32] claim 20, wherein the core [(1, 35)] has a polygon-shaped outer circumferential surface, consisting of individual plane-surfaced surface portions [(17)], whereby the surface portions [(17)] correspond to the dimensions of the permanent magnets [(2)] abutting the same.

34. (Amended) Rotor according to [one of claims 20-29, wherein the metal sheets (38) of steel are] claim 20, wherein the core is formed by a metal sheet packet comprising a plurality of metal sheets and a plurality of shear bolts inserted at one end into the metal sheets [(23)] and at [the other] a second end into the closure disks [(4, 5)].

ABSTRACT OF THE DISCLOSURE

The rotor has a core with an internal space. Permanent magnets are arranged on the core . These permanent magnets are surrounded by an outer cylinder, which is connected flush to closure disks which bear stub shafts. Channels run out from the internal space in the radial direction to the region of the permanent magnets. A resin mass is first introduced into the internal space. The rotor is thereafter heated and run up to centrifuging rotational speed. As a result, the molten resin mass flows through the channels to the region of the permanent magnets and fills up all the cavities present there and also cracks which form in the brittle permanent magnets on running up to speed. The resin mass hardens while the rotor is kept at centrifuging rotational speed. Each surface region of the permanent magnets is thus reliably protected against corrosion.

PROCESS FOR THE PRODUCTION OF A ROTOR, CONTAINING PERMANENT MAGNETS, OF A SYNCHRONOUS MACHINE, AND ROTOR PRODUCED ACCORDING TO THIS PROCESS

FIELD OF THE INVENTION

[0001] The present invention relates to the production of a rotor, containing permanent magnets, of a synchronous machine, which rotor has a core of ferromagnetic steel, on which and connected to the core of which are permanent magnets which in turn are surrounded by an outer cylinder of a non-magnetizable steel, and which rotor has closure plates of a non-magnetizable steel with a stub shaft.

BACKGROUND OF THE INVENTION

[0002] In the operation of a permanent magnet excited synchronous machine, the permanent magnets seated on the rotor are exposed to considerable centrifugal forces, with the consequence that they tend to come loose from the rotor. Shrinking on a metallic cylinder over the magnets seated on the rotor is known. The permanent magnets, as is well known, consist of a brittle material, so that cracks and breaks are already practically unavoidable when shrinking the cylinder on. These permanent magnets moreover consist of a material which is very susceptible to corrosion and have to be wholly surrounded by a protective layer which is also durable during operation. The application of such protective layers on the one hand requires much work and on the other hand, in known constitutions, leaves broken places on the permanent magnets, occurring on (a first) run-up to operating rotational speed, without any protection against corrosion. It is known that the permanent magnets have to be ground to obtain correct dimensions, This grinding also requires much work.

SUMMARY OF THE INVENTION

[0003] The invention has as its object to provide a process of production of a permanent magnet excited synchronous machine, and a rotor produced by this process, according to

which the permanent magnets are mounted hydrostatically, so to speak, and furthermore the permanent magnets also have no unprotected surfaces even after sustaining fractures after first running up to operating speed.

[0004] The process according to the invention is distinguished in that the core is constituted with an internal space, and a resin mass is introduced into the internal space and is supplied to the region of the permanent magnets by centrifuging the rotor, a hardening of the resin mass then taking part in the said region. The rotor produced by the process according to the invention is characterized by a core of ferromagnetic steel and an internal space extending axially, the permanent magnets being arranged on the said core and being surrounded by an outer cylinder of non-magnetizable material, the said rotor having closure disks of non-magnetizable steel at both ends with stub shafts, which are positively connected to the core and at least frictionally connected to the outer cylinder, and that all the cavities in the region of the permanent magnets are filled with a resin mass.

[0005] The advantages attained with the invention are in particular that the permanent magnets are completely surrounded by the resin mass and thus in actual fact are hydrostatically mounted, so that they are secured against a displacement due to centrifugal forces; and that the resin mass is still flowable during the first running-up to speed, so that it fills the cracked regions of the permanent magnets appearing during this period, and covers the additionally resulting bare surfaces of the permanent magnets.

BRIEF DESCRIPTION OF THE DRAWING

[0006] Preferred embodiments of the invention are discussed in the following description and illustrated in the accompanying drawings, in which:

[0007] Fig. 1 shows a longitudinal section through a first embodiment of the rotor according to the invention.

[0008] Fig. 2 shows a section along the line II-II of Fig. 1.

[0009] Fig. 3 shows a first embodiment of the connection between the outer cylinder and a closure disk of the rotor.

[0010] Fig. 4 shows a second embodiment of the connection between the outer cylinder and a closure disk of the rotor.

[0011] Fig. 5 shows a third embodiment of the connection between the outer cylinder and a closure disk of the rotor.

[0012] Fig. 6 shows, on an enlarged scale, a cross section through a portion of the rotor, in order to illustrate the filler strips.

[0013] Fig. 7 shows a longitudinal section, similar to that of Fig. 1, through a portion of a second embodiment of the rotor according to the invention.

[0014] Fig. 8 shows a diagram of a slotted sheet of a sheet metal packet shown in Fig. 7.

[0015] Fig. 9 shows a schematic view of a portion of a rotor with a cage.

[0016] Fig.10 shows a section along the line X-X of Fig. 9.

DETAILED DESCRIPTION OF THE INVENTION

[0017] The rotor of the first embodiment, shown in Fig. 1, has an integrally constituted core 1 of a ferromagnetic material. Permanent magnets 2 are arranged on the core 1. The permanent magnets are shown as one piece for the sake of clarity, but they can however also be arbitrarily divided. The permanent magnets 2 are surrounded by an outer cylinder 3 of a metallic, non-magnetizable material. The outer cylinder 3 can consist, for example, of high strength, cold-rolled, austenitic steel, or of a high strength bronze which conducts electricity well, e.g., $CuNi_3Si$, to achieve the smallest electrical surface losses. The rotor ends on both sides with a closure disk 4 or 5 with a stub shaft 6 or 7 which consists of non-magnetizable steel.

[0018] The core 1 has an internal space 8 constituted as an axial through bore, which serves as a storage space as will be described. Channels 27 run in a radial direction from the internal space 8 to the region of the permanent magnets 2.

[0019] The core 1 furthermore has a polygonal recess 18 at both axial ends. The closure disks 4 or 5 have a correspondingly shaped projection 19. The core 1 is centered on the closure disks 4 or 5 by means of these projections 19 and recesses 18, the polygonal shape moreover serving for excellent transmission of the torque of the core 1 to the closure disks

4 or 5 and thus to the stub shafts 6 or 7. Instead of a central projection 19, there can be an arrangement of shear bolts 38 which connect the core 1 to the closure disks 4 or 5.

[0020] Fig. 2 shows a section through the rotor along the line II-II of Fig. 1. It can be seen that the permanent magnets 2 seated on the core 1 are encircled by the outer cylinder 3, and the core 1 has the internal space 8. In a known manner, the rotor forms a north pole N and a south pole S in the 2-pole embodiment shown here by way of example. Lateral, magnetically neutral zones 37 are present, as is generally known. Filler pieces 16 of a magnetizable or non-magnetizable material, according to the desired magnetic salience, are inserted at these neutral zones 37, in the corresponding annular space portions between the outer cylinder 3 and the core 1. The density of the material of these filler pieces 16 is advantageously at least approximately equal to the density of the material of the permanent magnets 2, that is, the density of the filler pieces 16 is advantageously similar to the density of the permanent magnets 2.

[0021] For the assembly of the rotor, the outer cylinder 3, according to a variant, is shrunk onto the closure disks 4 or 5.

[0022] The final connection between the outer cylinder 3 and the closure disks 4 or 5 takes place according to a first embodiment, which is shown in Fig. 3, by means of a tight peripheral weld seam 9. As will be described hereinafter, the production of this tight peripheral weld seam 9 takes place in two steps.

[0023] A further embodiment of the connection between the shrunk-on outer cylinder 3 and the closure disks is shown in Fig. 4.

[0024] The outer cylinder 3 of this embodiment has at both ends an inner circumferential groove 10. The respective closure disk 4 or 5 has a corresponding outer circumferential projection 11. Near this outer circumferential projection 11 is an outer circumferential groove 12 with an O-ring 13 inserted into it. If the outer cylinder 3 is shrunk onto the respective closure disk 4 or 5, the respective outer circumferential projection 11 projects into the respective inner circumferential groove 10. Furthermore, the respective O-ring 13 directly abuts the outer cylinder 3.

[0025] Fig. 5 shows a further variant of the connection between the outer cylinder 3 and the closure disk 4 or 5, in which no shrinking-on takes place. The respective closure disk 4 or 5 has for this purpose a cone-shaped portion 14 facing toward the rotor interior. This cone-shaped portion 14 ends in a shoulder portion 15 formed as a stop. In this embodiment, the closure disks 4, 5 are hydraulically pressed in over the cone-shaped portion 14 until they come to abut on the shoulder portion 15 in the outer cylinder 3.

[0026] Reference is made to Fig. 6 in addition to Fig. 5. The core 1 shown in Fig. 6 has a polygonal circumferential surface. The dimensions of the flat-surfaced surface portions 17 of the outer circumference of the core 1 correspond to the dimensions of the permanent magnets 2 arranged on it. Thus the circumferential surface of the core 1 conforms to the contour of the permanent magnets 2, so that no large magnetic gap is present. Furthermore, excellent transmission of torque from the permanent magnets 2 to the core 1 results from this polygonal shaping of the circumferential surface of the core.

[0027] Filler strips 20 of a dimensionally stable, preferably metallic, material are arranged between the individual permanent magnets 2. These filler strips can be provided with a thin nonwoven covering for fitting purposes, at least opposite the permanent magnets. Further filler strips 21 are arranged between the permanent magnets 2 and the opposing inner circumferential regions of the outer cylinder 3. These further filler strips 21 consist of material which conducts well, e.g., Cu or Al.

[0028] Excellent fitting to the rectangular cross sectional shape of the permanent magnets 2 is made possible by the filler strips 20, 21. If absolutely necessary, only the faces of the permanent magnets 2 facing the outer cylinder 3 are ground; for the rest, all the surfaces can remain unworked.

[0029] The further filler strips 21 are connected at their ends to a flexibly constituted ring 22 which conducts electricity well; see also Fig. 5. This ring 22 can consist of a braided wire or can be of laminated construction. The connection of the further filler strips 21 to the flexible ring 22 can take place by welding, e.g., spot welding.

[0030] These further filler strips 21 together with the ring 22 thus form a damping cage. During assembly of the rotor, these weld connections are produced before the positioning and securing of the closure disks 4, 5 on the outer cylinder 3.

[0031] In the embodiment shown in Fig. 7, the core, generally denoted by the reference numeral 35, is embodied of stacked metal sheets 23. These metal sheets 23 are arranged as a metal sheet packet on a centering tube 24. The centering tube 24 has holes 25 running in a radial direction. The metal sheets 23 arranged in the neighborhood of these holes 25 have a longitudinal slot 26 and are stacked in a cyclically rotated arrangement (see Fig. 8), so that passages from an internal space 36 of the centering tube 24 to the region of the permanent magnets 2 are present, analogous to the channels 27 of the first embodiment.

[0032] Instead of the centering tube 24, the metal sheets 23 can be perforated in order to be able to receive shear bolts 38. These shear bolts 38 can project in over the length of the metal sheet packet and into the closure disks 4, 5, in order to transmit torque.

[0033] The embodiment with a core 35 of a metal sheet packet is a precondition for an oscillating magnetization. However, this embodiment has no damping cage according to that of the embodiment shown in Figs. 5 and 6.

[0034] The reference numeral 28 in Fig. 7 denotes, in each closure disk, periodically annularly positioned threaded holes to receive balancing screws (not shown) for balancing the rotor. Alternatively, bores with desired diameter and depth can be bored during balancing.

[0035] A yet further embodiment is shown in Figs. 9 and 10. A cage 29 with end rings 30 and longitudinal rods 31 is produced from a material (e.g., Cu, Al) which conducts well, and acts as an electrical damping cage in the finished rotor. To assemble the rotor, this cage 29 is pushed into the outer cylinder 3. The individual permanent magnets 2 are inserted into the cage 29, which serves as a filling matrix, and are adhered to the outer cylinder with a provisional adhesive. Thereupon the core 1 is pushed into the cage 29, and the closure disks 4, 5 are then mounted.

[0036] Alternatively, the cage 29 with the permanent magnets 2 can first be arranged on the core 1 and then the outer cylinder 3 can be pushed over them.

[0037] The purpose of the transverse grooves 32 in the longitudinal rods 31 will be explained hereinafter.

[0038] To complete the rotor according to the invention, a resin mass is introduced into the internal space 8, serving as a storage space, of the core 1, or in the embodiment according to Fig. 7, into the internal space 36 of the centering tube 24. Such resin masses are generally known and thus do not have to be described further. These resin masses can furthermore contain fillers, e.g., an aluminum oxide powder. Advantageously, the resin mass is introduced in the form of a solid rod, as a so-called B-stage adhesive.

[0039] The rotor is then run up to speed and simultaneously heated, according to a predetermined time program. The program can include steady state points at intermediate rotational speeds and intermediate temperatures. The resin mass, now molten, thus penetrates through the channels 27 in the core 1 or, in the embodiment of Fig. 7, through the holes 25 in the centering tube 24 and through the longitudinal slots 26 in the relevant metal sheets 23, in a radially outward direction toward the permanent magnets 2. The transverse grooves 32 described in Fig. 9 serve to equalize the flow of the resin mass.

[0040] The resin mass flowing outward due to the centrifugal force fills all the cavities present, and the permanent magnets 2 are completely surrounded by the resin mass. Since it is known that cracks and fractures unavoidably occur in the brittle permanent magnets when the rotor is first run up to speed, these regions also are reliably filled by the flowable resin mass.

[0041] The hardening of the resin mass takes place at the centrifuging speed of the rotor. This speed is higher than the maximum rotational speed and is only applied during manufacture of the rotor.

[0042] The region of the inner level of the resin mass after centrifuging is shown in Fig. 1 by the arrows 33 and 34 and also by the dashed lines. The resin mass to be filed into the internal space is thereby determined.

[0043] Due to the hardening of the resin mass during centrifuging, the outer cylinder 3 remains prestressed at the later rotational speeds and when stationary.

[0044] It is to be mentioned that the peripheral weld seam 9 described in connection with Fig. 3 is pre-welded only in a single pass before the described course of hardening. The circumferential weld seam 9 is completely after-welded only after the course of hardening. The outer cylinder 3 is seated on cooled clamp jaws (not shown) during the welding process. The balancing of the rotor takes place at the threaded holes 28, described in Fig. 7, after the course of hardening. The internal space 8 in the core 1, or the internal space 36 of the centering tube 25, can furthermore serve as a so-called heat pipe and be cooled via the stub shafts 6, 7 or by means of flanged-on heat exchangers. It is within the scope of the present invention that the rotor has a stub shaft at only one side, and the other end remains free. The closure disk at the free end remains for sealing purposes.

[0045] It is thus apparent that the permanent magnets are mounted hydrostatically, so to speak, and in particular that cracks occurring when the rotor is first run up to speed are filled with the molten resin mass, so that the permanent magnets are completely locked in from the ambient atmosphere and thus are extremely corrosion-resistant.

[0046] The permanent magnets can be provided with insulating coatings in order to prevent current paths to adjacent electrically conducting components.

[0047] As an alternative mode of manufacture, prestressed flat binding strips can be placed around the permanent magnets and possible damper rods 21 before the installation of the outer cylinder 3. The permanent magnets can then be magnetized in an oscillating manner. The rings 22 are thereafter applied, without however removing the strips. Alternatively, the filler strips 20 can likewise consist of material which conducts electricity well, and can be connected to the rings 22.

[Process for the Production of a Rotor, Containing Permanent Magnets, of a Synchronous Machine, and Rotor Produced According to this Process] PROCESS FOR THE PRODUCTION OF A ROTOR, CONTAINING PERMANENT MAGNETS, OF A SYNCHRONOUS MACHINE, AND ROTOR PRODUCED ACCORDING TO THIS PROCESS

[Technical Field]
FIELD OF THE INVENTION

[0001] The present invention relates to the production of a rotor, containing permanent magnets, of a synchronous machine, which rotor has a core of ferromagnetic steel, on which and connected to the core of which are permanent magnets which in turn are surrounded by an outer cylinder of a non-magnetizable steel, and which rotor has closure plates of a non-magnetizable steel with a stub shaft.

[State of the Art]
BACKGROUND OF THE INVENTION

[0002] In the operation of a permanent magnet excited synchronous machine, the permanent magnets seated on the rotor are exposed to considerable centrifugal forces, with the consequence that they tend to come loose from the rotor. Shrinking on a metallic cylinder over the magnets seated on the rotor is known. The permanent magnets, as is well known, consist of a brittle material, so that cracks and breaks are already practically unavoidable when shrinking the cylinder on. These permanent magnets moreover consist of a material which is very susceptible to corrosion and have to be wholly surrounded by a protective layer which is also durable during operation. The application of such protective layers on the one hand requires much work and on the other hand, in known constitutions, leaves broken places on the permanent magnets, occurring on (a first) run-up to operating rotational speed, without any protection against corrosion. It is known that the permanent magnets have to be ground to obtain correct dimensions, This grinding also requires much work.

[Summary of the Invention]

SUMMARY OF THE INVENTION

[0003] The invention has as its object to provide a process of production of a permanent magnet excited synchronous machine, and a rotor produced by this process, according to which the permanent magnets are mounted hydrostatically, so to speak, and furthermore the permanent magnets also have no unprotected surfaces even after sustaining fractures after first running up to operating speed.

[0004] The process according to the invention is distinguished in that the core is constituted with an internal space, and a resin mass is introduced into the internal space and is supplied to the region of the permanent magnets by centrifuging the rotor, a hardening of the resin mass then taking part in the said region. The rotor produced by the process according to the invention is characterized by a core of ferromagnetic steel and an internal space extending axially, the permanent magnets being arranged on the said core and being surrounded by an outer cylinder of non-magnetizable material, the said rotor having closure disks of non-magnetizable steel at both ends with stub shafts, which are positively connected to the core and at least frictionally connected to the outer cylinder, and that all the cavities in the region of the permanent magnets are filled with a resin mass.
[Advantageous embodiments will be apparent from the dependent claims.]

[0005] The advantages attained with the invention are in particular that the permanent magnets are completely surrounded by the resin mass and thus in actual fact are hydrostatically mounted, so that they are secured against a displacement due to centrifugal forces; and that the resin mass is still flowable during the first running-up to speed, so that it fills the cracked regions of the permanent magnets appearing during this period, and covers the additionally resulting bare surfaces of the permanent magnets.

[Brief Description of the Drawing]

BRIEF DESCRIPTION OF THE DRAWING

[0006] [Several embodiment examples] **Preferred embodiments** of the invention are [shown in the drawings.]

discussed in the following description and illustrated in the accompanying drawings, in which:

[0007] Fig. 1 shows a longitudinal section through a first embodiment of the rotor according to the invention~~;~~.

[0008] Fig. 2 shows a section along the line II-II of Fig. 1~~;~~.

[0009] Fig. 3 shows a first embodiment of the connection between the outer cylinder and a closure disk of the rotor~~;~~.

[0010] Fig. 4 shows a second embodiment of the connection between the outer cylinder and a closure disk of the rotor~~;~~.

[0011] Fig. 5 shows a third embodiment of the connection between the outer cylinder and a closure disk of the rotor~~;~~.

[0012] Fig. 6 shows, on an enlarged scale, a cross section through a portion of the rotor, in order to illustrate the filler strips~~;~~.

[0013] Fig. 7 shows a longitudinal section, similar to that of Fig. 1, through a portion of a second embodiment of the rotor according to the invention~~;~~.

[0014] Fig. 8 shows a diagram of a slotted sheet of a sheet metal packet shown in Fig. 7~~;~~.

[0015] Fig. 9 shows a schematic view of a portion of a rotor with a cage~~;~~.

[0016] Fig.10 shows a section along the line X-X of Fig. 9.

[Modes of Embodiment of the Invention]

DETAILED DESCRIPTION OF THE INVENTION

[0017] The rotor of the first embodiment, shown in Fig. 1, has an integrally constituted core 1 of a ferromagnetic material. Permanent magnets 2 are arranged on the core 1. The permanent magnets are shown as one piece for the sake of clarity, but they can however also be arbitrarily divided. The permanent magnets 2 are surrounded by an outer cylinder 3 of a metallic, non-magnetizable material. The outer cylinder 3 can consist, for example, of high strength, cold-rolled, austenitic steel, or of a high strength bronze which conducts electricity well, e.g., $CuNi_3Si$, to achieve the smallest electrical surface losses. The rotor

ends on both sides with a closure disk 4 or 5 with a stub shaft 6 or 7 which consists of non-magnetizable steel.

[0018] The core 1 has an internal space 8 constituted as an axial through bore, which serves as a storage space as will be described. Channels 27 run in a radial direction from the internal space 8 to the region of the permanent magnets 2.

[0019] The core 1 furthermore has a polygonal recess 18 at both axial ends. The closure disks 4 or 5 have a correspondingly shaped projection 19. The core 1 is centered on the closure disks 4 or 5 by means of these projections 19 and recesses 18, the polygonal shape moreover serving for excellent transmission of the torque of the core 1 to the closure disks 4 or 5 and thus to the stub shafts 6 or 7. Instead of a central projection 19, there can be an arrangement of shear bolts 38 which connect the core 1 to the closure disks 4 or 5.

[0020] Fig. 2 shows a section through the rotor along the line II-II of Fig. 1. It can be seen that the permanent magnets 2 seated on the core 1 are encircled by the outer cylinder 3, and the core 1 has the internal space 8. In a known manner, the rotor forms a north pole N and a south pole S in the 2-pole embodiment shown here by way of example. Lateral, magnetically neutral zones 37 are present, as is generally known. Filler pieces 16 of a magnetizable or non-magnetizable material, according to the desired magnetic salience, are inserted at these neutral zones 37, in the corresponding annular space portions between the outer cylinder 3 and the core 1. The density of the material of these filler pieces 16 is advantageously at least approximately equal to the density of the material of the permanent magnets 2, that is, the density of the filler pieces 16 is advantageously similar to the density of the permanent magnets 2.

[0021] For the assembly of the rotor, the outer cylinder 3, according to a variant, is shrunk onto the closure disks 4 or 5.

[0022] The final connection between the outer cylinder 3 and the closure disks 4 or 5 takes place according to a first embodiment, which is shown in Fig. 3, by means of a tight peripheral weld seam 9. As will be described hereinafter, the production of this tight peripheral weld seam 9 takes place in two steps.

[0023] A further embodiment of the connection between the shrunk-on outer cylinder 3 and the closure disks is shown in Fig. 4.

[0024] The outer cylinder 3 of this embodiment has at both ends an inner circumferential groove 10. The respective closure disk 4 or 5 has a corresponding outer circumferential projection 11. Near this outer circumferential projection 11 is an outer circumferential groove 12 with an O-ring 13 inserted into it. If the outer cylinder 3 is shrunk onto the respective closure disk 4 or 5, the respective outer circumferential projection 11 projects into the respective inner circumferential groove 10. Furthermore, the respective O-ring 13 directly abuts the outer cylinder 3.

[0025] Fig. 5 shows a further variant of the connection between the outer cylinder 3 and the closure disk 4 or 5, in which no shrinking-on takes place. The respective closure disk 4 or 5 has for this purpose a cone-shaped portion 14 facing toward the rotor interior. This cone-shaped portion 14 ends in a shoulder portion 15 formed as a stop. In this embodiment, the closure disks 4, 5 are hydraulically pressed in over the cone-shaped portion 14 until they come to abut on the shoulder portion 15 in the outer cylinder 3.

[0026] Reference is made to Fig. 6 in addition to Fig. 5. The core 1 shown in Fig. 6 has a polygonal circumferential surface. The dimensions of the flat-surfaced surface portions 17 of the outer circumference of the core 1 correspond to the dimensions of the permanent magnets 2 arranged on it. Thus the circumferential surface of the core 1 conforms to the contour of the permanent magnets 2, so that no large magnetic gap is present. Furthermore, excellent transmission of torque from the permanent magnets 2 to the core 1 results from this polygonal shaping of the circumferential surface of the core.

[0027] Filler strips 20 of a dimensionally stable, preferably metallic, material are arranged between the individual permanent magnets 2. These filler strips can be provided with a thin nonwoven covering for fitting purposes, at least opposite the permanent magnets. Further filler strips 21 are arranged between the permanent magnets 2 and the opposing inner circumferential regions of the outer cylinder 3. These further filler strips 21 consist of material which conducts well, e.g., Cu or Al.

[0028] Excellent fitting to the rectangular cross sectional shape of the permanent magnets 2 is made possible by the filler strips 20, 21. If absolutely necessary, only the faces of the permanent magnets 2 facing the outer cylinder 3 are ground; for the rest, all the surfaces can remain unworked.

[0029] The further filler strips 21 are connected at their ends to a flexibly constituted ring 22 which conducts electricity well; see also Fig. 5. This ring 22 can consist of a braided wire or can be of laminated construction. The connection of the further filler strips 21 to the flexible ring 22 can take place by welding, e.g., spot welding.

[0030] These further filler strips 21 together with the ring 22 thus form a damping cage. During assembly of the rotor, these weld connections are produced before the positioning and securing of the closure disks 4, 5 on the outer cylinder 3.

[0031] In the embodiment shown in Fig. 7, the core, generally denoted by the reference numeral 35, is embodied of stacked metal sheets 23. These metal sheets 23 are arranged as a metal sheet packet on a centering tube 24. The centering tube 24 has holes 25 running in a radial direction. The metal sheets 23 arranged in the neighborhood of these holes 25 have a longitudinal slot 26 and are stacked in a cyclically rotated arrangement (see Fig. 8), so that passages from an internal space 36 of the centering tube 24 to the region of the permanent magnets 2 are present, analogous to the channels 27 of the first embodiment.

[0032] Instead of the centering tube 24, the metal sheets 23 can be perforated in order to be able to receive shear bolts 38. These shear bolts 38 can project in over the length of the metal sheet packet and into the closure disks 4, 5, in order to transmit torque.

[0033] The embodiment with a core 35 of a metal sheet packet is a precondition for an oscillating magnetization. However, this embodiment has no damping cage according to that of the embodiment shown in Figs. 5 and 6.

[0034] The reference numeral 28 in Fig. 7 denotes, in each closure disk, periodically annularly positioned threaded holes to receive balancing screws (not shown) for balancing the rotor. Alternatively, bores with desired diameter and depth can be bored during balancing.

[0035] A yet further embodiment is shown in Figs. 9 and 10. A cage 29 with end rings 30 and longitudinal rods 31 is produced from a material (e.g., Cu, Al) which conducts well, and acts as an electrical damping cage in the finished rotor. To assemble the rotor, this cage 29 is pushed into the outer cylinder 3. The individual permanent magnets 2 are inserted into the cage 29, which serves as a filling matrix, and are adhered to the outer cylinder with a provisional adhesive. Thereupon the core 1 is pushed into the cage 29, and the closure disks 4, 5 are then mounted.

[0036] Alternatively, the cage 29 with the permanent magnets 2 can first be arranged on the core 1 and then the outer cylinder 3 can be pushed over them.

[0037] The purpose of the transverse grooves 32 in the longitudinal rods 31 will be explained hereinafter.

[0038] To complete the rotor according to the invention, a resin mass is introduced into the internal space 8, serving as a storage space, of the core 1, or in the embodiment according to Fig. 7, into the internal space 36 of the centering tube 24. Such resin masses are generally known and thus do not have to be described further. These resin masses can furthermore contain fillers, e.g., an aluminum oxide powder. Advantageously, the resin mass is introduced in the form of a solid rod, as a so-called B-stage adhesive.

[0039] The rotor is then run up to speed and simultaneously heated, according to a predetermined time program. The program can include steady state points at intermediate rotational speeds and intermediate temperatures. The resin mass, now molten, thus penetrates through the channels 27 in the core 1 or, in the embodiment of Fig. 7, through the holes 25 in the centering tube 24 and through the longitudinal slots 26 in the relevant metal sheets 23, in a radially outward direction toward the permanent magnets 2. The transverse grooves 32 described in Fig. 9 serve to equalize the flow of the resin mass.

[0040] The resin mass flowing outward due to the centrifugal force fills all the cavities present, and the permanent magnets 2 are completely surrounded by the resin mass. Since it is known that cracks and fractures unavoidably occur in the brittle permanent magnets when the rotor is first run up to speed, these regions also are reliably filled by the flowable resin mass.

[0041] The hardening of the resin mass takes place at the centrifuging speed of the rotor. This speed is higher than the maximum rotational speed and is only applied during manufacture of the rotor.

[0042] The region of the inner level of the resin mass after centrifuging is shown in Fig. 1 by the arrows 33 and 34 and also by the dashed lines. The resin mass to be filed into the internal space is thereby determined.

[0043] Due to the hardening of the resin mass during centrifuging, the outer cylinder 3 remains prestressed at the later rotational speeds and when stationary.

[0044] It is to be mentioned that the peripheral weld seam 9 described in connection with Fig. 3 is pre-welded only in a single pass before the described course of hardening. The circumferential weld seam 9 is completely after-welded only after the course of hardening. The outer cylinder 3 is seated on cooled clamp jaws (not shown) during the welding process. The balancing of the rotor takes place at the threaded holes 28, described in Fig. 7, after the course of hardening. The internal space 8 in the core 1, or the internal space 36 of the centering tube 25, can furthermore serve as a so-called heat pipe and be cooled via the stub shafts 6, 7 or by means of flanged-on heat exchangers. It is within the scope of the present invention that the rotor has a stub shaft at only one side, and the other end remains free. The closure disk at the free end remains for sealing purposes.

[0045] It is thus apparent that the permanent magnets are mounted hydrostatically, so to speak, and in particular that cracks occurring when the rotor is first run up to speed are filled with the molten resin mass, so that the permanent magnets are completely locked in from the ambient atmosphere and thus are extremely corrosion-resistant.

[0046] The permanent magnets can be provided with insulating coatings in order to prevent current paths to adjacent electrically conducting components.

[0047] As an alternative mode of manufacture, prestressed flat binding strips can be placed around the permanent magnets and possible damper rods 21 before the installation of the outer cylinder 3. The permanent magnets can then be magnetized in an oscillating manner. The rings 22 are thereafter applied, without however removing the strips.

Alternatively, the filler strips 20 can likewise consist of material which conducts electricity well, and can be connected to the rings 22.

[List of Reference Numerals

1 core

2 permanent magnets

3 outer cylinder

4 closure disk

5 closure disk

6 stub shaft

7 stub shaft

8 internal space

9 circumferential weld seam

10 inner circumferential groove

11 outer circumferential projection

12 outer circumferential groove

13 O-ring

14 cone-shaped portion

15 shoulder portion

N north pole

S south pole

16 filler piece

17 surface portion of the polygonal circumferential surface

18 recess

19 projection

20 filler strips

21 (further) filler strips

22 ring

23 metal sheet

24 centering tube

25 holes

26 longitudinal slot

27 channel

28 threaded hole

29 cage

30 end ring

31 longitudinal rods

32 transverse grooves

33 arrow

34 arrow

35 core

36 internal space

37 neutral zone

38 shear bolt]